FIELD OBSERVATIONS OF THE MEDITERRANEAN FRUIT FLY AND THE ORIENTAL FRUIT FLY IN THE NATIONAL PARK

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Introduction

The Mediterranean fruit fly or medfly, Ceratitis capitata (Wiedemann) has been an economic pest here in the Hawaiian Islands since the early 1900's (Christenson and Foote, 1960). Today its distribution has been reduced to small localized populations due to the introduction of another tephritid species, the Oriental fruit fly, Dacus dorsalis Hendel (Bess, 1953). Through the years, an abundance of literature has been collected on this species but of these references, only a few have described basic behavioral actions (Martelli, 1910; Back and Pemberton, 1918; Feron, 1962; Prokopy and Hendrichs, 1979) and none have described these actions in a detailed analysis. With its recent infestations into California, the urgent need for control of the medfly has warranted more basic information on this pest. To accomplish this goal, field observations of the medfly have become increasingly important because of the potential bias of laboratory observations. Such observations have been accomplished in Kula, Maui where certain aspects of the medfly mating behavior has been observed. Observations to locate similar behavior sites in the National Park were conducted. The following describes the medfly mating behavior as well as sightings of the medfly and the oriental fruit fly in the National Park.

Medfly Mating Behavior

The mating behavior of the medfly can be sequenced into four major groups of actions (Figure 1): 1. Acquisition of courting site 2. Pheromone calling 3. Courtship 4. Copulation.

Acquisition of courting site. Prior to the initiation of courtship, a male selects and defends a territory within which he will court. In the field, this territory was determined to be the underside of the leaves of various plants. The acquisition of such a site is a very important part of the courtship pattern but what is even more striking is that these males form aggregations of territories or leks. Males have been observed on the underside of leaves (one male per leaf) grouped in a specific section of a tree.

Pheromone calling. Once a male has acquired a territory from which he will court, he will begin a series of actions cumulatively known as "pheromone calling" (Prokopy and Hendrichs, 1979). The actions in pheromone calling are performed through three pathways (Figure 2) which originates with the male in the orientation position. These pathways can be performed in any order and repeated many times during calling. Male orientation position: Wings are extended laterally such that the vanes are parallel to the substrate with the front costal margin directed upward. The distal end of the abdomen is curled upward away from the substrate. Simultaneously, part of the rectal epithelium is everted forming a large globule which is coated with the sex pheromone.

From the orientation position, the male can enter into two pathways (A and C) with a third pathway (B) intervening. Pathway A (Fanning):

From the orientation position, the male will lower his abdomen and tuck it under his body with the rectal epithelium still everted. Simultaneously, the male will begin to vibrate his wings as well as beat them such that a fanning motion is created. Pathway B (Fanning/Reorientation): During fanning, the male will reorient himself so that he now faces a different direction. After reorientation, the male may continues to fan, reoreint, or enter into Pathway C. Pathway C (Wing Lifts/Reorientation): Once he has assumed a position, the male will perform a series of wing lifts at a 45^{o} to his body. While lifting his wings, the male may turn such that he is now facing another direction. Once a new direction is selected, the male resumes his orientation position.

Courtship. If a receptive female should land within the courting arena while the male is in the state of "calling", the male will immediately reorient himself so that he directly faces the female. Once reoriented to the female, the male will begin a series of fanning motions. These motions are very similar to those observed during pheromone calling but the interval between each fanning motion is shorter at this stage of courtship. Should the female continue her submissive role by remaining relatively motionless in the general vicinity, the male will continue to advance toward her. The male while still fanning his wings, will initiate a series of head movements oscillating his head in both directions to a maximal point where the plane of the normal position of the head is rotated 45^{o} in both directions. As he performs these head movements, the male will walk closer to the female such that he is almost or is physically touching her with his second pair of fronto-orbital bristles. At this point, the male will attempt to mount the female.

Copulation. From the face-to-face position, the male jumps onto the female's back and then turns himself around such that he is positioned in the same direction as the female. If the female has not moved or has not released herself from the surface of the leaf, she has indicated her acceptance of that male and extends her ovipositor leading to copulation.

Field Observations in Kipuka Ki

Kipuka Ki has been used for medfly research for several years. The host fruit utilized in this area is Jerusalem cherry, Solanum pseudocapsicum. Samples of fruits collected from this area yielded a high proportion of medflies with smaller numbers of Oriental fruit flies and fruit fly parasites. In searching for lek sites in Kipuka Ki, medfly females were observed ovipositing into Jerusalem cherries.

During one trip to this area, medflies and Oriental fruit flies were observed on the underside of the leaves of Coprosma sp. Both species appeared to be involved in courtship actions though close observations was not possible at the time. We have not been able to confirm such sightings on subsequent trips to this site.

On another trip to this area, orange flagging tape and a red sheet of plastic were exposed on a tree and within minutes, a few hundred Oriental fruit flies and a few medflies appeared. The numbers on the red plastic sheet were large enough that displacement and competition among the flies occurred. What is interesting is that the large numbers of Oriental fruit flies observed indicate that this species is present in surrounding vegetation and further searching is necessary to determine

the location of these flies. However, the numbers of Oriental fruit flies reared from the Jerusalem cherries seem to indicate that these flies are breeding in something else or there is a larger population of medflies that is not being attracted.

Field Observations in Kipuka Puaulu

In trying to locate medfly sites in this area, both the Oriental fruit fly and the medfly were found on the underside of leaves of several native plants including soapberry, koa, and kolea. Of these trees, the kolea, Myrsine lessertiana, proved to be extremely interesting because of the large number of Oriental fruit flies observed on the leaves of these trees during the course of the day. Also, one medfly male was observed on one of the trees during the observational periods. The Oriental fruit flies were seen on the underside of the leaves in a similar position as that observed in the medfly. In addition, from the handful of fruits which were collected from the lower branches of the kolea, two medfly females were reared.

Conclusions

These sightings of the medfly and the Oriental fruit fly are significant because the findings indicate that both the medfly and the Oriental fruit fly can survive at higher altitudes and that at least one and possibly more native plants serve as hosts for the medfly. Also, the presence of these economic pests within the National Park must be considered in the implementation of control programs because of the abundant endemic flora and fauna which also exists there.

Finally, these sites serve as "natural laboratories" for continued medfly studies and for potential reserach on the Oriental fruit fly. My goal is to locate the medfly mating sites within these areas and to corrolate this information with data from other sites. These kinds of data would then provide further basis for research on the medfly.

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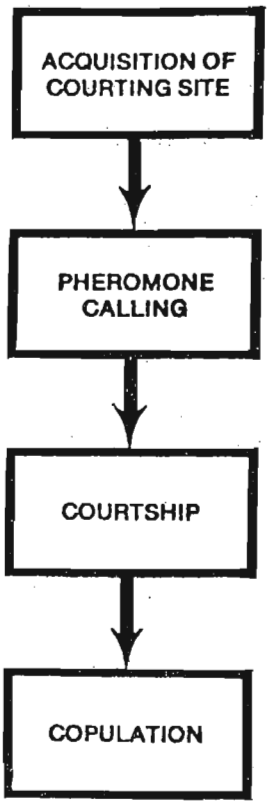

Fig. 1. Basic steps in the mating behavior of the Mediterranean fruit fly.

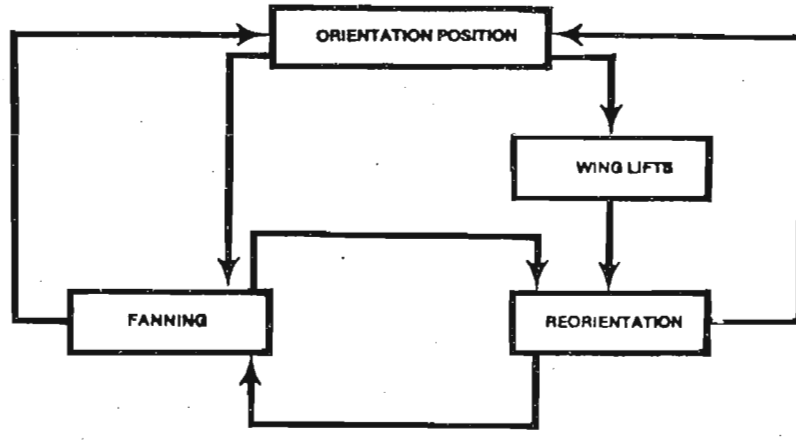

Fig. 2. Schematic diagram of pheromone calling behavior in the Mediterranean fruit fly.

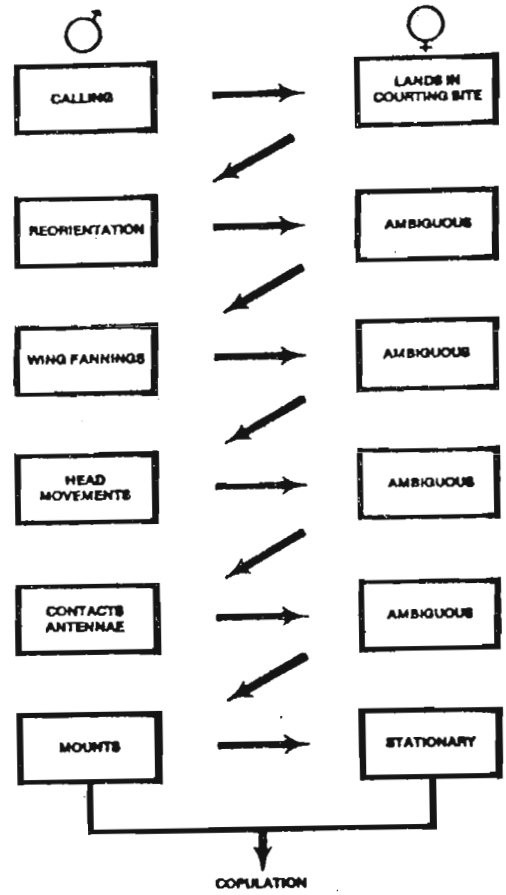

Fig. 3. Basic courtship sequence in the Mediterranean fruit fly.